Translator note: the subscript "i" may be a "1" in some cases; copy was not clear enough to distinguish (eg "D3i")

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Title of Invention: Light Control Device

Abstract

Object: To provide a light control device with which display panel noise arising from the variability in LED lamp luminance characteristics is eliminated, and capable of adjusting the luminance of an entire display panel at once, and of appropriately adjusting contrast and chrominance.

Constitution: A light control device 1 which receives the color signals R,G, B and sync signals SV and SH supplied to a CRT display section 3b, and, in sync with a dot clock Ddot, outputs address data ADi identifying each LED to an LED-comprised display panel 2, and gradation data D3i, specifying luminance data for each LED; [the device] is provided with a surface luminance control section 19, which receives surface luminance control data Dbr specifying the luminance of the whole display panel and changes the gradation data output levels.

Claims

Claim 1

In a light control device which receives chrominance and sync signals output by an image generating device, and, in sync with a dot clock, outputs address data identifying each light emitting element and gradation data specifying luminance for each light emitting element to a display panel comprising multiple light emitting elements, the light control device is characterized in that it receives surface luminance regulation data specifying the luminance of the whole display panel and, based on this surface luminance regulation data, selects one of a number of correction curves previously stored in memory, correcting the aforementioned gradation data output levels by means of these correction curves.

Claim 2.

In a light control device which receives chrominance and sync signals output by an image generating device, and, in sync with a dot clock, outputs address data identifying each light emitting element and gradation data specifying luminance for each light emitting element to a display panel comprising multiple light emitting elements, the light control device is characterized by comprising an individual luminance correction section, which stores in a memory circuit chrominance characteristic data indicating the chrominance characteristics for each of the aforementioned light emitting elements and, based on this chrominance characteristic data, selects one of a number of correction curves previously stored in a memory circuit and corrects the aforementioned gradation data based on these correction curves.

Claim 3

The light control device according to Claim 1, characterized in that the aforementioned surface luminance regulation section is provided with a rewritable memory circuit for storing correction curves, and is connected to a correction curve

generating device; the correction curve generating device automatically generates multiple correction curves based on specified light control conditions.

Claim 4

The light control device according to Claim 2, characterized in that the aforementioned individual luminance correction section is provided with a rewritable memory circuit for storing the luminance characteristic data for each light emitting element, automatically generating luminance characteristic data based on the results of a measurement of the luminance of each light emitting element using a light emitting element luminance measuring device, and downloading these luminance characteristic data to a memory circuit in the aforementioned individual luminance correction section.

Claim 5

The light control device according to Claim 2, characterized in that when multiple corrections are implemented having differing objectives, such as surface luminance regulation and individual luminance regulation, an overall light regulation is implemented by distributing correction circuits, which correct the aforementioned gradation data according to correction curves previously stored in accordance with objective, in multiple hierarchical levels as needed.

Claim 6

Any of the light control devices described in Claims 1 through 5 characterized in that the aforementioned light emitting element is an LED.

Detailed Description of the Invention

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Industrial Field of Application

The present invention relates to a light control device which outputs gradation data to an LED display panel, etc.; in particular, it relates to a light control device which

outputs gradation data in which a luminance or other correction has been carried out for each LED lamp.

0002

Prior Art

The LED display panel is comprised of a combination of multiple dot matrix modules MOi comprising, for example, 16 x 16 pixels (Fig. 3); each pixel comprises, for example, 3 types of LED emitting the 3 primary colors. The LED light control device is a device for causing an image to be displayed on this LED display panel; it is a device which, in sync with a dot clock Ddot, outputs the gradation data Di specifying the luminance of each LED, and the address data ADi identifying which LED should be illuminated based on the relevant gradation data, to a dot matrix module MOi (see Fig. 13). At the same time, each dot matrix module MOi comprises, as shown in Fig. 14, a dedicated memory 31 which stores gradation data Di in sync with the dot clock Ddot, a pulse width conversion circuit 32 which outputs a pulse width modulation wave based on a dedicated memory 31 output data, an output circuit 33 which supplies the pulse wave modulation (PWM) wave to the relevant LED lamp in response to the data readout timing from the dedicated memory 31, and so forth. Fig. 13 depicts a circuit for one of the 3 primary colors (RGB); similar circuits are provided for the other 2 colors.

0003.

The pulse width conversion circuit 32 in Fig. 13 receives the Di output from the dedicated memory 31 and outputs a pulse width PWM wave in response to this value. Fig. 15 depicts an example of a PWM wave; shown here is a PWM wave in which the repeating frequency is fixed and only the pulse width changes. The output circuit 33 is a circuit which switches the connection relationship between the pulse width conversion circuit 32 and the LED lamps in response to data readout timing from the dedicated memory 31; the PWM wave is thus sequentially supplied to the relevant LED. The dot matrix module MOi shown in Fig. 14 is arranged such that luminance correction in units of each module MOi can be effected by operation of a

knob, etc. This luminance correction includes a pulse width correction method in which a specified vale for the gradation data with respect to all the LED lamps (for example 16 x 16) within the module is added or subtracted, and a power supply correction method, in which a common drive voltage to the LED lamps within the module is variably adjusted.

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Problems the Invention Seeks to Resolve

However, the aforementioned methods are no more than a uniform regulation per module unit; there are some cases in which display panel noise cannot be canceled even with luminance correction. That is, the reality is that there is some variability in the luminance characteristics (sensitivity) of each LED beyond what was present at the time of manufacturing, such that it is not possible to eliminate noise stemming from the variability in each lamp's luminance characteristics using a uniform luminance regulation per each module unit. Also, there is no mechanism in conventional light control devices for adjusting the display luminance of an entire display panel at once, so that if one wanted to adjust the luminance of an entire display panel in response to ambient brightness, etc., there was no alternative but to adjust the luminance of each of multiple dot matrix modules individually, which was extremely inconvenient. Furthermore, with conventional display panels there was the additional inconvenience that contrast and chrominance regulation were not possible, and luminance regulation circuits had to be provided for each dot matrix module, which was wasteful from the standpoint of circuit configuration. The present invention was undertaken with these problems in mind, with the object of providing a light control device with which display panel noise stemming from variability in LED lamp luminance characteristics can be eliminated, luminance of the entire display panel can be adjusted at once, and contrast and chrominance control can be appropriately effected.

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Means for Resolving Problems

Invention of Claim 1

In order to achieve the above-described objectives, the light control device according to Claim 1 is a light control device which receives chrominance and sync signals output by an image generating device, and, in sync with a dot clock, outputs address data identifying each light emitting element and gradation data specifying luminance for each light emitting element to a display panel comprising multiple light emitting elements, the light control device characteristically comprising a surface luminance adjustment section which receives surface luminance regulation data specifying the luminance of the whole display panel and, based on this surface luminance regulation data, selects one of a number of correction curves previously stored in memory, correcting the aforementioned gradation data output levels by means of these correction curves.

Invention of Claim 2.

Also, the light control device of Claim 2 is a light control device which receives chrominance and sync signals output by an image generating device, and, in sync with a dot clock, outputs address data identifying each light emitting element and gradation data specifying luminance for each light emitting element to a display panel comprising multiple light emitting elements, the light control device characteristically comprising an individual luminance correction section, which stores in a memory circuit chrominance characteristic data indicating the chrominance characteristics for each of the aforementioned light emitting elements and, based on this chrominance characteristic data, selects one of a number of correction curves previously stored in a memory circuit and corrects the aforementioned gradation data based on these correction curves.

Invention of Claims 3 and 4

The surface luminance adjustment section and individual luminance correction section memory circuits correspond to ROM and RAM circuits in Claims 1 and 2, but a rewritable memory circuit is cited in the light control device of Claims 3 and 4. Also, the aforementioned surface luminance adjustment section is connected to the

correction curve generating device, and this correction curve generating device automatically generates the aforementioned multiple correction curves based on designated light control conditions, downloading these correction curves to the aforementioned surface luminance adjustment section memory. The correction curve generating device may be comprised of a computer system such as a personal computer. The aforementioned individual element luminance correction section can be connected to a light emitting element luminance measurement device; this light emitting element luminance measuring device measures the luminance of each light emitting element and downloads this luminance characteristic data to the aforementioned individual element luminance correction section memory. The light emitting element luminance measurement device may comprise a TV camera or luminance meter with a personal computer or other computer system.

0008

Operation

The surface luminance regulation section receives surface luminance regulation data and, based on that value, changes the gradation data output level; it is capable of changing the luminance of the entire aforementioned display panel at once. The individual luminance correction section stores luminance characteristic data indicating the luminance characteristics of each light emitting element, and changes the gradation data output level based on this luminance characteristic data value, such that even if individual light emitting elements differ in luminance characteristics (sensitivity), gradation data generating the same image as the reference image can be output. The light emitting elements are not particularly limited, but the present invention is particularly effective with respect to LEDs, which have a large variability in luminance characteristics.

0009

Embodiments

Below we shall explain the present invention in further detail based on embodiments.

Embodiment 1

Figs. 1 and 2 depict the interconnections between the LED light control device of the present invention and other devices. The light control device 1 is connected to a display panel 2 and a personal computer 3 as shown in Fig. 2, such that the color screen created on the personal computer 3 is displayed on the display panel 2. The display panel 2 comprises n dot matrix modules MO1 - Mon. The display section of each dot matrix module MOi is formed of 16 x 16 pixels (Fig. 3), and each pixel comprises 3 types of LED lamps, which emit red (R), green (G), and blue (B) light. In the present embodiment, the LED display panel 2 dot count is set to be 320 horizontal x 240 vertical (Fig. 4), such that the number n of dot matrix modules MO is 20 x 15 = 300.

0010

Each dot matrix module MOi comprises a personal computer 3 which stores the gradation data D3i from the light control device 1, a PWM wave generating circuit 5 which generates a pulse width modulation (PWM) wave based on the memory 4 data, and a output section 6 which sequentially supplies the PWM wave to each LED lamp. In Fig. 2, the circuit configuration for only one of the 3 primary colors is shown; the circuit configuration for the other 2 colors is similar. The personal computer 3 is formed of a 3ax and a 3bx; the 3bx has 640 horizontal x 480 vertical dot pixels (Fig. 4). Therefore in this embodiment 1/4th of the 3bx screen is reproduced on the display panel 2.

0011

The light control device 1 is a device in which the personal computer 3 receives an analog RGB signal and a horizontal sync signal SH and vertical sync signal SV, dot clock Ddot and address data AD1, and gradation data D3i are output to the dot matrix modules MO1 - MOn; circuit configuration is as shown in Fig. 5. Here the dot

clock Ddot is a frequency (approx. equal to 29 MHz) corresponding to the 3bx pixel count (640 x 480); address data ADi is the address information which specifies each 3bx pixel. The gradation data D3i is gradation data after all corrections have been made; each dot matrix module MOi LED lamp illuminates based on this corrected gradation data D3i. With respect to the 640 x 480 pixel count of the 3bx, the display panel 2 has a pixel count of 320 x 240, and therefore only 1/4 of the gradation data D3i output from the light control device 1 are stored in each dot matrix module MOi memory 4.

0012

As shown in Figs. 5 and 6, the light control device 1 comprises a CCD line sensor 7, and address data generating section 8, a color signal A/D conversion section 9, a luminance setting section 10, and surface luminance adjustment section 11, and a individual unit luminance correction section 12. In Fig. 5, only the circuit for the red (R) signal is depicted; similar circuits are provided for the green (G) and blue (B) signals. The dot clock generating section 7 is a PLL circuit which receives a horizontal sync signal SH from the personal computer 3 and outputs the dot clock Ddot; it comprises a phase comparator 13, a low frequency filter 14, a voltage control oscillator 15, and a N-base counter 16 (Fig. 6). The dot clock Ddot, locked to the horizontal sync signal SH, is therefore output from the dot clock generating section 7. If we let the horizontal sync frequency SH be fH, then the dot clock Ddot frequency is N x fH, or approximately 29 MHz.

0013

The address data generating section 8 comprises a 640-base counter 8a and a 480-base counter 8b (Fig. 6). The 640 base counter 8a is a circuit which is set by the horizontal sync frequency SH and counts up the dot clock Ddot, outputting address data from 0 to 639. At the same time, the 480-base counter 8b is a circuit which is set by the vertical sync frequency SV and counts up the address data from 0 to 479. The color signal A/D conversion section 9 is a circuit which converts the analog signal (the R signal here) output from the personal computer 3 to an 8 bit

digital signal; it operates using the above described dot clock Ddot as a sampling pulse. The luminance setting section 10 is a circuit which outputs a 3 bit luminance regulation signal Dbr in response to the value of regulation volume VR (Fig. 5). The regulation volume VR is a volume whose purpose is the regulation of the luminance of the whole display panel 2; it changes the luminance of the whole LED panel in response to light surrounding the LED display panel during the day, evening , night, etc. To change the regulation volume VR, a light sensor may be provided, or the digital signal luminance regulation signal Dbr can be directly provided from outside the device.

0014

The surface luminance adjustment section 11 comprises a delay circuit 17 with respect to the dot clock Ddot, a delay circuit 18 with respect to the address data ADi, and a surface luminance adjustment memory 19 (Fig. 5). The delay circuits 17 and 18 are circuits which cause a delay in the dot clock Ddot and address data ADi signal transmission, taking into account the access time to the surface luminance adjustment memory 19. That is to say, a time skew of approximately several 10s of nS occurs between the gradation data D1i supplied to the surface luminance adjustment memory 19 and the post-correction gradation data D2i output from the surface luminance adjustment memory 19, and therefore a delay time equal to this is secured by the delay circuits 17 and 18. The surface luminance adjustment memory 19 is an 8 x 2048 bit (16 kbit) memory with 11 address bits (A0 - A10) and 8 data bits (D0 - D7). The gradation data D1i from the color signal A/D conversion section 9 is supplied to the lower address 8 bits (A0 - A7) and the luminance regulation signal Dbr from the luminance setting section 10, etc. is supplied to the upper address 3 bits (AA-8 - A10). The surface luminance adjustment memory 19 is therefore divided into 8 banks according to the value of the luminance regulation signal Dbr (Fig. 7); in other words the luminance regulation signal Dbr functions as a bank switching signal.

0015

As shown in Fig. 7, 256 data types implementing lines are stored in each of the surface luminance adjustment memory 19 banks. These correction lines become steeper as the memory bank [address] increases, such that the higher the Luminance regulation signal Dbr, the greater will be the change in width of the post-correction gradation data D2i output from the surface luminance adjustment memory 19. When the change width of the D2i ix large, the LED display panel 2 luminance contrast will also be large, which is suitable when the area surrounding the display panel 2 is bright, as in daylight. Conversely, when the lower memory banks are selected, the post-correction gradation data D2i change width will be small, which is suitable for dark conditions surrounding the display panel 2, such as at night. In Fig. 7, the case in which the contents of the surface luminance adjustment memory 19 increase linearly is shown as an example, but, as will be described below, it is also possible to make this increase curved (Fig. 12) to achieve special image effects.

0016

The individual unit luminance correction section 12 corrects the variability in luminance characteristics (sensitivity) of each of the 320 x 240 LED lamps (for a single color), while at the same time performing a gradient correction to match the luminance specified by the gradation data D2i with the luminance actually perceived by the human eye. It comprises a delay circuit 20 for the dot clock Ddot, a delay circuit 21 for the address data ADi, a delay circuit 23 for the gradient data D2i, a luminance characteristic data memory 22, and a gradient correction memory 24 (Fig. 5) The delay circuit 23 matches the output timing of the gradient data D2i and the luminance characteristic data memory 22 output data Dsens. The delay circuit 20 and the delay circuit 21 match the output timing of the gradient correction memory 24 output data D3i, the dot clock Ddot, and the address data ADi.

0017

The luminance characteristic data memory 22 stores the luminance characteristics for each of the 240 x 320 LED lamps which comprise the display panel 2, in

accordance with (0, 0) - (239, 319) address information. The LED lamp luminance characteristics vary somewhat from the beginning, and further change over time; the luminance of each LED lamp when illuminated under the same drive conditions is sorted into 8 classes and stored. The LED lamp is then specified according to the address data ADi from the delay circuit 18, and the specified LED lamp luminance characteristic data Dsens is supplied to the upper address bits (A8 - A10) of the gradient correction memory 24.

0018

In order to match the luminance specified by the gradient data to the luminance actually perceived by the human eye, 8 correction curves of the non-linear type shown in Fig. 8 are stored in the gradient correction memory 24. Based on the correction curve 0 the with respect to the maximum sensitivity LED lamp, it is possible for example to generate other correction curves (1 - 7) by multiplying this correction curves 0 by a fixed multiplier. The luminance data Dsens is supplied to the gradient correction memory 24 upper address bits (A8 through A10) such that this luminance but characteristic data Dsens functions as a bank switching signal. At the same time, the gradient data D2i is supplied to the lower address bits (A0 - A7), such that the gradient data D3i selected according to the gradient data D2i is output within the specific memory bank selected based on the luminance characteristics of each LED lamp. In other words, the output gradient data D3i is gradient data in which human sensory characteristics have been added together with the luminance characteristics of each LED lamp.

0019

Figure 9 explains the operation which occurs in the gradient correction memory 24; depicted is the case in which gradient data D2i = 100 is supplied to 2 LEDs of differing luminance characteristics. In the case of Fig. 9(a), the sensitivity (luminance characteristics) of the relevant LED lamps is good, and therefore the gradient data D2i = 100 is gradient corrected to an output gradient data of D3i = 95. In the case of Fig. 9(b), meanwhile, the relevant LED lamp sensitivity is poor, such

that the gradient data D2i = 100 is strengthened when gradient corrected, and a gradient data D3i = 105 is output. Gradient data is thus corrected in response to the luminance characteristics of each LED lamp, and therefore the 2 LED lamps are driven ad gradient data of 95 and 105, but have the same luminance regardless of their differing luminance characteristics.

0020

As explained above, address data ADi corresponding to each pixel (640 x 480) of the 3ax, and gradient data D3i on which all types of correction have been implemented, are synchronized from the light control device 1 to the approximately 29 MHz dot clock Ddot and output. Then, by means of the address data ADi, the relevant address module MOi and relevant address in memory 4 are selected, and gradient data D3i is sequentially stored. The gradient data D3i stored in the memory 4 is added to the PWM wave generating circuit 5 to generate a PWM wave, and the generated PWM wave is supplied to each LED lamp through the output section 6. The RGB analog signal created in the personal computer 3 is thus added to the dot matrix module MO after A/D conversion and appropriate correction, such that the same color screen as appears on the 3ax is displayed on the display panel 2. In this case, gradient data Di is corrected to reflect the luminance characteristics of the LED lamps which comprise the display panel 2, so no [illeg] noise based on differing LED lamp luminance characteristics will appear.

0021

Embodiment 2

In the above explanation of the LED light control device shown in Fig. 5, the surface luminance adjustment memory 19, the luminance characteristic data memory 22, and the gradient correction memory 24 are shown as ROM as an example, but each memory 19, 22, and 24 can also be comprised of RAM, with the stored contents thereof appropriately rewritten from an external source. Fig. 10 depicts an embodiment wherein each of the memories 19, 22, and 24 is comprised of RAM; the interconnections between the light control device 1, the display panel 2, the

personal computer 3, a personal computer 30, and a dedicated memory 31 are depicted. The personal computer 30 composes a luminance characteristic data file based on the signal from the dedicated memory 31, which is sent as needed to the luminance characteristic data memory 22. Also, while sending the contents of a pre-composed data file to the surface luminance adjustment memory 19 and the gradient correction memory 24, the contents of the data file for the surface luminance adjustment memory 19 are revised as needed. Fig. 11 depicts the personal computer screen when correcting the data file for the surface luminance adjustment memory 19. A "display adjustment" column 32 and "RGB luminance adjustment" column 33 appear on the personal computer screen, and corrections can be made using the mouse cursor 34 or keyboard.

0022

The "display adjustment" column 32 is used to adjust the display panel 2 contrast. After setting the RAM data composing personal computer 30, changing the "brightness" column 32b level with a keyboard or other operation results in a data correction to change the slope of the Fig. 7 correction curve. In this case, the luminance adjustment data composed in the personal computer 30 is immediately sent to the surface luminance adjustment memory 19, such that the display panel 2 brightness changes in response to operation of the personal computer 30, and adjustment is easily effected. The "reference correction pattern" column 32c numbers are indicate the Fig. 7 correction curve number; here it is indicated that the personal computer 3 slope is adjusted. IN the display adjustment mode, meanwhile, changing the level of the "contrast" column 32a results in a change of the Fig. 7 correction curve shape from the standard curve b shape shown in Fig. 12 to a high contrast curve a or low contrast curve c shape. When display panel 2 brightness and contrast adjustment is completed according to the above operation, the mouse cursor 34 is moved to the "set memory" column 32d and the luminance adjustment data file contents are updated using the post-adjustment data. Adjustment in the pulse width conversion circuit 32 uniformly adjusts red (R), green (G), and blue (B), and the correction curve for each color is [also] uniformly adjusted.

0023

In this regard, the "RGB luminance adjustment" column 33 is used to perform a luminance adjustment (white balance) on each color. After setting the RAM data composing personal computer 30 to the "RGB luminance adjustment" mode, changing the "brightness" column 33 levels 33R, 33G, 33B by keyboard or other operation causes data to be corrected so as to change the correction curve (Fig. 7) slope for the selected color. In this case as well, the luminance adjustment data composed in the personal computer 30 is immediately sent to the light control device 1 surface luminance adjustment memory 19, and therefore the tint of the display panel 2 changes in response to operation of the personal computer 30, making adjustment easy. The number which appears in the "mid-adjustment correction pattern number" column 33c indicates the Fig. 7 correction curve number. When adjustment is completed, the mouse cursor 34 is moved to the "settings memory" column 32d position, and the surface luminance adjustment data file contents are updated using the post-adjustment data.

0024

We continue with an explanation of the method for composing the luminance characteristic data file. First, the light control device 1 is appropriately operated so as to set up a state in which the post-A/D conversion RGB signal is output as is as the gradient data Di without any correction. Thereafter, the single color red is composed on the image composing personal computer 3 and a reference R signal is output at a specified level. After A/D conversion, this reference R signal is added with no correction whatsoever to the dot matrix module MO, such that a solid color screen with light and dark in accordance with the luminance characteristics of each LED lamp (red) is displayed on the display panel 2. In this state, the dedicated memory 31 is imaging the display panel 2 screen, and therefore the personal computer 30 analyzes the video signal from the dedicated memory 31 and luminance characteristic data is created for each LED lamp (red) and stored in a luminance characteristic data file.

0025

Next a single color green screen is prepared on the image creating personal computer 3, and a specified level reference G signal is output. The personal computer 30 analyzes the image signal for the signal green color from the dedicated memory 31 and records the luminance characteristic for each LED lamp (green) in a luminance characteristic data file. The same is true for the LEDs which emit blue light; a single blue light is caused to be displayed on the display panel 2, the lightness and darkness thereof is analyzed by the personal computer 30, and a luminance characteristic data file is created. Data in the luminance characteristic data files created as described above are downloaded to the luminance characteristic data memory 22 at an appropriate timing. A TV camera was used in the above explanation, but a luminance meter could also be used. Also, we illuminated the 3 primary color LEDs simultaneously, but it would also be possible, for example, to illuminate the red LEDs one at a time, and then illuminate the green LEDs one at a time, and then illuminate the blue LEDs one at a time. It would also be acceptable to illuminate all of the 3 primary color LED lamps simultaneously and create a luminance characteristic data file for each LED lamp.

0026

Effect of the Invention

As explained above, the light control device according to the present invention comprises a surface luminance adjustment section and an individual element luminance correction section; it is capable of changing the luminance of the entire aforementioned display panel and of outputting gradation data which creates the same image as a reference image, regardless of differences in the luminance characteristic (sensitivity) of the individual light emitting elements.

Brief Description of Figures

Fig. 1 A diagram conceptually depicting the interconnections between the light control device of the present invention and other devices.

Fig. 2 A detailed diagram of the interconnections shown in Fig. 1.

Fig 3 A diagram conceptually depicting the display panel constitution.

Fig. 4 A diagram showing the size relationship between the display panel and the personal computer display screen.

Fig. 5 An internal block diagram of the light control device depicted in Fig. 1.

Fig. 6 A block diagram showing details of a portion of Fig. 5.

Fig. 7 A diagram conceptually depicting the contents of the luminance adjustment memory.

Fig. 8 A diagram of the content of the gradient correction memory.

Fig. 9 An example of the operation of the gradient correction memory.

Fig. 10 A diagram of the interconnection between the light control device and display panel, the image creation personal computer, the computer for RAM data creation, and the TV camera.

Fig. 11 A diagram showing an example of the personal computer for RAM data creation.

Fig. 12. A diagram illustrating the case in which the contents of the luminance adjustment memory are changed.

Fig. 13 A diagram of the dot clock, address data, and gradient data operational timing.

Fig. 14 A figure illustrating a conventional circuit example with respect to the dot matrix module.

Fig. 15. A diagram of the PWM wave waveform.

Reference Numerals

1. Light control device
2. Display panel
3. Personal computer (image generating device)

19. luminance adjustment memory (surface luminance adjustment section)

22. Luminance characteristic data memory (individual unit luminance correction section)

24. Gradient correction memory (individual element luminance correction section)

RGB: Color signals

SV, SW: Sync signal

ADi: Address data

D3i: Gradient data

Ddot: Dot clock

Dbf: surface luminance adjustment data

Dsens: luminance characteristic data